R. R. RYMILL
PENOLA

NOT TO BE PUBLISHED

The information given in this document is not to be communicated, either directly or indirectly, to the Press or to any person not holding an official position in His Majesty's Service.

THIS DOCUMENT MUST NOT FALL INTO ENEMY HANDS

MAP READING

SUPPLEMENT

A.T.M. (AUST.) No. 13

By Authority : Victorian Railways Printing Works, North Melbourne.
2525—42

SUPPLEMENT

A.T.M. (AUST.) No. 13

MAP READING

MAP READING:

A knowledge of map reading is an essential part of a soldier's military education, and implying as it does, an understanding of the magnetic compass, may on occasion prove of inestimable value to the soldier when thrown upon his own resources.

WHAT IS A MAP?

A map is a representation on paper of a portion of the earth's surface. It is drawn to scale, and shows NATURAL features such as hills, valleys, rivers, lakes, etc., and ARTIFICIAL features, such as roads, railways, bridges, towns, etc. NO map is perfectly accurate, and few are up to date.

WHY DO WE USE MAPS?

It may not be possible to inspect ground over which operations will take place; and even if the ground can be inspected it is difficult to remember all the features seen. A map enables us to obtain a clear idea of the ground. It also saves time before a ground reconnaissance, provides a means of giving quick references to locations and permits an appreciation of a military situation in all its aspects.

WHAT SHOULD WE KNOW ABOUT A MAP?

(1) The LOCALITY it deals with. (2) Its SCALE. (3) Its ORIENTATION and LOCAL MAGNETIC VARIATION. (4) The CONVENTIONAL SIGNS used. (5) Its CONTOUR system and INTERVAL. (6) Its SYSTEM of REFERENCE and GRID employed. (7) DATE OF ISSUE or REVISION. (8) AUTHORITY for ISSUE. (9) Adjoining sheets.

DEFINITIONS OF TOPOGRAPHICAL FORMS: (only less common forms given below).

It is necessary that we should be able to describe various ground features by their correct names, and vice versa.

COL or SADDLE: A neck of land connecting two adjacent hills or mountains. It is lower than the two features it connects but higher than the surrounding plain or valley.

CREST: The general line formed by joining the summits of the main ridge of a chain of mountains.

FALSE CRESTS: The line along which a lower steep slope changes to an upper gentle slope—also known as BROW or MILITARY CREST.

DUNE: A hill or ridge of sand formed by wind action.

DEFILE: Any feature, natural or artifical, which causes a body of troops to contract its normal frontage during its passage through it.

ESCARPMENT: An extended line of cliffs or bluffs.

KNOLL: A low detached hill.

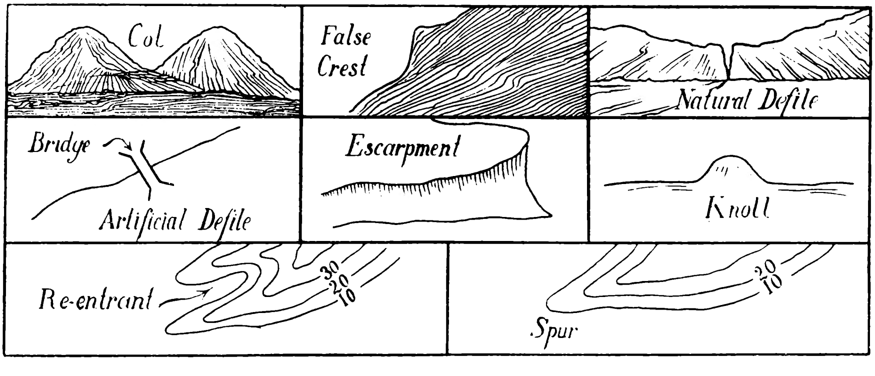
MAIN or SALIENT FEATURES: Those important forms such as ridges, drainage systems, etc., which determine the shape of the country.

RE-ENTRANT: A re-entrant occurs where the hillside is curved inwards towards the main feature, i.e., between two spurs.

SPUR or SALIENT: A projection from the side of a hill or mountain running out of the main feature.

WATER-COURSE: The line defining the lowest part of a valley, whether occupied by a stream or not.

(Definitions of technical terms are given as they occur in the notes.)



SCALES

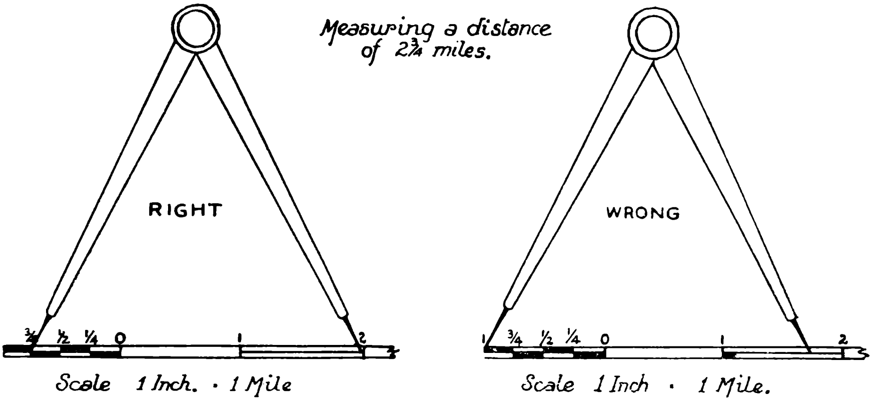
HOW DO WE DETERMINE DISTANCE ON A MAP?

By measuring the distance between the two points, and applying it to the scale—which is found in the margin of the map.

Method: An easy method of measuring distance between points on the map is the use of a pair of dividers. By means of these, it is simple to follow the changes of direction of a road by stepping out the distance between corners and so gradually widening the gap between the two points of the dividers. The dividers are then placed against the scale and the aggregate distance can be read. If dividers are not available the distances should be marked off along the straight edge of a piece of paper and the aggregate can be compared with the scale.

When measuring road distances on the map, much time can be saved by using existing road markers, whether in miles or kilometres. Whatever method is used, care should be taken to ensure that the amount of error is kept at a minimum.

In reading from the scale, it should be noted that the odd fractions of a mile are provided for on the extreme left. Therefore one point of the dividers should be placed on an even mile (or other unit) and the odd fraction of the unit read at the left hand side. The illustration will explain the point.



Measuring a distance of 2¾ miles.

WHY DOES A MAP NEED A SCALE?

Because without one there would be no means of comparing distances on the map with distances on the ground and vice versa.

WHAT IS A SCALE?

(a) Used in connection with map reading, the word SCALE means the proportion which the length between two points on a map bears to the horizontal distance between the same two points on the ground. Thus, if we say that a map has a scale of ONE INCH to ONE MILE, we mean that a length of **one inch** on the map would represent **one mile** on the ground and vice versa.

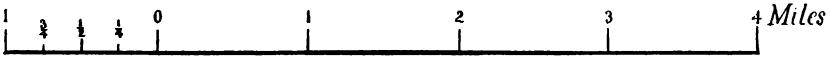
(b) SCALE also denotes a line drawn on the map, and suitably divided so that measurement of distance can be made, with its assistance, on the map in question.

SCALE LINE:

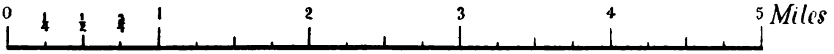
This is a straight line divided and indicated to show what proportion distances on the map bear to the actual distances on the ground which they represent. When the scale line is divided as in (a) page 4, it is termed an "open divided" scale. The divisions to the left of zero

(0) are termed "secondaries," and those to the right of it "primaries." Should the scale line be divided as in (b) below, it is called a "fully divided" scale, and it will be noted that zero is now shown at the left of the scale line.

(a)



(b)



HOW DO WE EXPRESS A SCALE?

Besides the printed line mentioned above, the scale can be described in two ways:

(i) By a statement in words showing the relation between any unit on the map, and any other on the ground.

(ii) By what is termed the REPRESENTATIVE FRACTION—(abbreviated to R.F.) which expresses the same relation as just given in terms of a fraction—with "one" as numerator, the denominator being expressed in the same unit, e.g. 1/100.

EXAMPLES OF SCALES: (1) English scales are generally made to show a certain number of INCHES to the MILE, or, MILES to an INCH. The statement is usually MILES to ONE INCH for the one inch and smaller scales, and in INCHES to the MILE for larger scales.

(2) Countries which use the "metre" as the unit of length, use CENTIMETRES to a KILOMETRE.

(3) An R.F. of 1/100 would mean that 1 inch on the map would equal 100 inches on the ground.
To give actual examples—

R.F. 1/63360 means that **one inch** on the map equals **one mile** on the ground.

R.F. 1/100,000 means than one centimetre on the map equals 100,000 cms. (1 kilometre) on the ground.

N.B. To find "statement in words" from a given R.F.

Divide denominator of R.F. by 63360 to get "number of miles on ground corresponding to one inch on map."

Divide 63360 by denominator of R.F. to get "number of inches on map corresponding to one mile on ground."

HAVE ALL MAPS THE SAME SCALE?

NO. Different types of maps require different scales. Thus imagine we have a sheet of paper a foot square. On this paper we could map in, say, 144 square miles of country. To do this we should use a comparatively small scale of one mile to one inch. On the other hand on this same square foot of paper we could draw in, say, 9 square miles of the same country, but in this case our scale would be a larger one of four inches to one mile. From this we may gather that the smaller the scale the less detail will be shown, but a greater area of ground will be covered, and conversely, the larger the scale the greater the detail shown, but a lesser area of ground will be covered.

WHAT SCALES FIT DIFFERENT MAPS?

Maps supplied to the army vary in scale from ¼ inch to the mile to 2½ inches to the mile. SMALL SCALE maps (¼ inch equals 1 mile) are used for very mobile operations, transport and communications. STANDARD SCALE (1 inch equals 1 mile) for normal training and operations. LARGE SCALE (2½ inches equals 1 mile) for special training, and pre-arranged operations.

CONVENTIONAL SIGNS.

Most maps do not allow room for outline plans of objects and so conventional signs are used. These signs are suggestive of the things they represent.

These conventional signs differ from country to country and even upon different maps of the same country. For military purposes additional details are required, e.g., sites of HQs, batteries, dugouts, etc.; and/or these additional signs are used. These latter signs are liable to change in order to avoid giving information to the enemy. The Air Force also has some special signs—while for field sketching, the signs are usually simplified. Lists of the various signs in use on English maps are to be found in the "Manual of Map Reading," and in "Notes on Map Reading." The more common signs should be memorised, but where a map employs a large number of signs, reference may be made to the LEGEND, usually to be found in the margin of all military maps.

(See Appendices I and II for Conventional Signs in use on Australian Military Maps.)

HILL FEATURES:

Relief, or shape of land surface can be shown in several ways, e.g., by contours, spot heights, shading, hachures, layer-tinting, etc. Sometimes two or more of these means are combined. On the majority of military maps the two most important are shown together, i.e., contours and spot heights.

WHAT IS A CONTOUR?

CONTOURS are lines on a map representing imaginary lines on the surface of the ground, indicating successive heights above, or below, mean sea level. They indicate the same height throughout their length.

HOW CAN WE DEMONSTRATE CONTOURS?

Imagine a solid pyramid standing in an empty tub. Now pour water in until there is a depth of 1 inch in the tub. Draw a line around the pyramid level with the surface of the water. Pour in another inch of water and mark another line. Continue pouring in successive inches of water and drawing lines until the pyramid is covered. Remove the model and note that it is marked with a succession of lines which are vertically 1 inch above the other. These lines are CONTOURS.

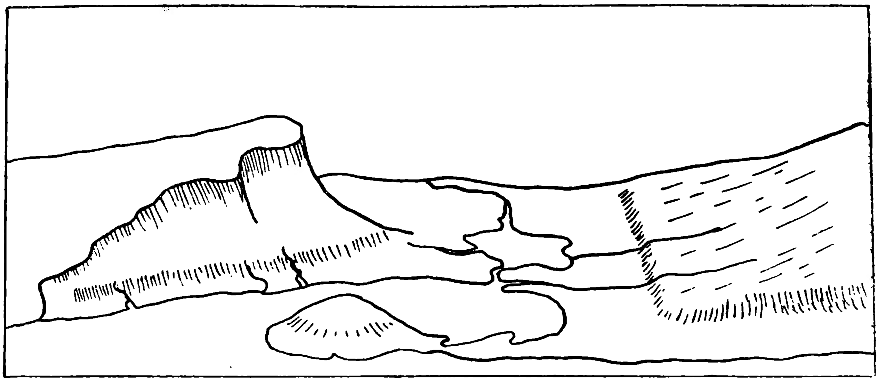
WHAT IS A SPOT HEIGHT?

A means of showing any height which lies between two adjacent contours. Found on most maps.

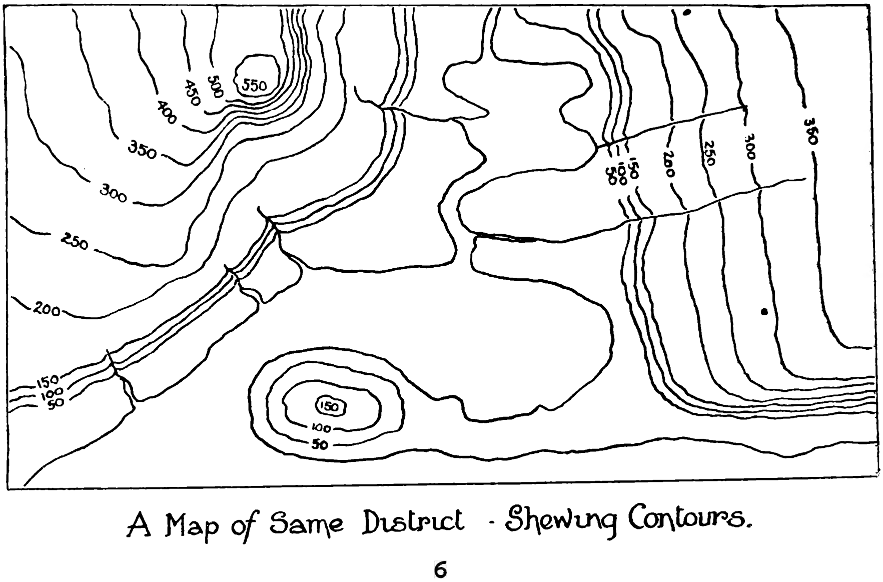
WHAT IS VERTICAL INTERVAL AND HORIZONTAL EQUIVALENT?

V.I. is the difference in **height** between two adjacent contours. The V.I. of any map is usually given in the margin.

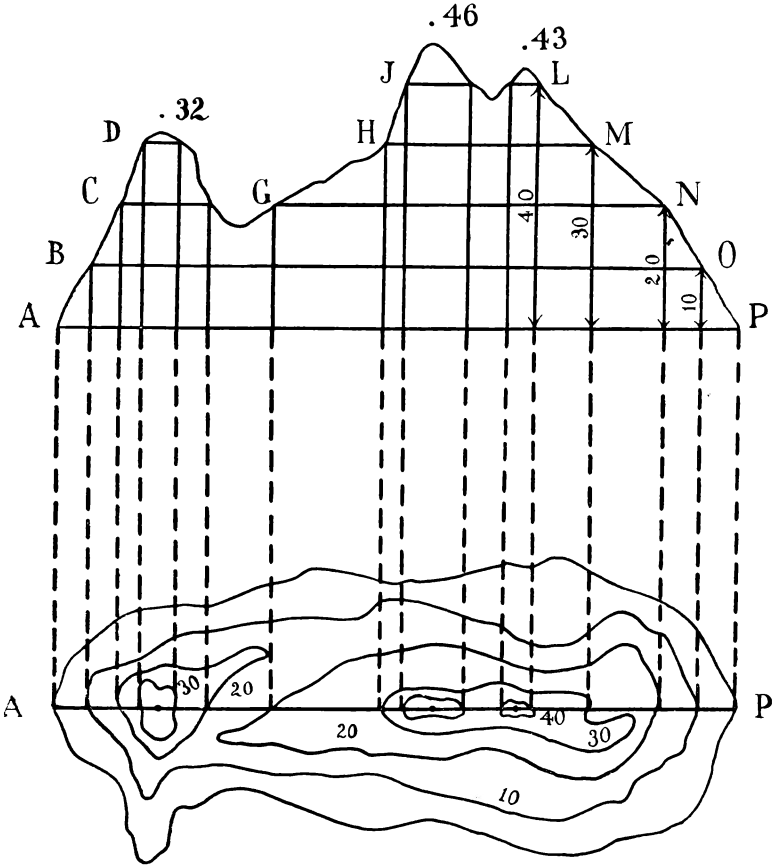
H.E. is the difference in **plan** between two adjacent contours. See sketch.



Panoramic View of District Shown on Map.



A Map of Same District - Shewing Contours.



Section and Plan of hill showing
variations in HE VI = 10ft

Note the V.I. is constant between all contours. In this case it is 10ft. Now look at G and H. The V.I. between them is 10ft. but the distance between them in plan is much more. This is the H.E. and it may vary between each adjacent pair of contours. Note the different H.E. between H and J, N and O. Note also how the spot heights show minor differences in height which the contours do not show. The spot heights shown are 32- 43-46ft.

WHY DO WE NEED TO KNOW V.I. AND H.E.?

Because by means of them it is possible to find the rise and fall of ground between two points, and so to find whether slopes are usable by M.T. Vehicles, etc.

EXAMPLE:

A certain M.T. column, fully loaded, cannot climb gradients steeper than 1/5, and it is required to find out from the map whether a hill road between A and B is passable. We know from the margin of the map what the V.I. is—in this case 50ft. By measurement from the scale, we find the minimum H.E. to be 300ft. Now gradient is equal to V.I. divided by H.E. Therefore we work out a simple sum. GRADIENT equals V.I./H.E. which equals 50/300 which cancels to 1/6. As we know the M.T. column can pass a gradient of 1/5, it is reasonable to assume the road is usable.

POINTS TO NOTE:

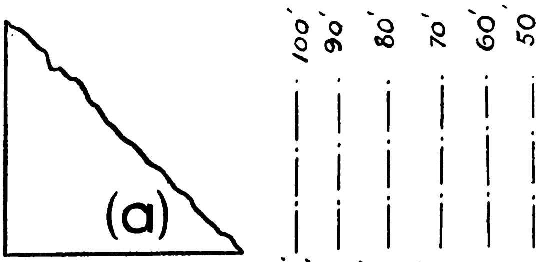
(1) The H.E. is found by measuring the distance on the map between adjacent contours, and then finding from the scale what this distance is on the ground.

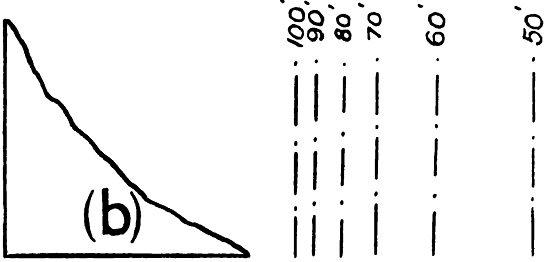
(2) The V.I. and the H.E. must be expressed in the same units, e.g., feet and feet, or yards and yards.

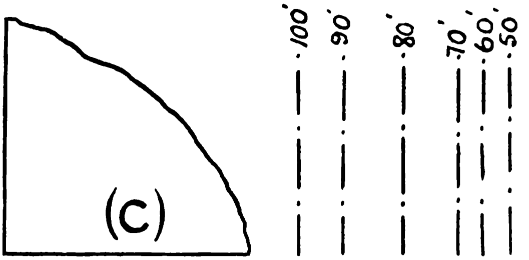
(3) A gradient is expressed as a fraction, say 1/10. This means simply that for every ten units in plan along a road, its surface will rise 1 unit.

WHAT DO CONTOURS SHOW?

The relative position and curvature of contours affords clear evidence of the shape of the ground, and unless we can grasp what the contours mean we cannot understand our map, or the ground it represents.







HOW ARE CONTOURS READ?

Contours are no use unless the height is indicated but it is not necessary for every contour to be marked with its height. Again, the V.I. must be known, otherwise wrong impressions will be gathered from the contour distances. Let us see how various types of slopes are shown.

UNIFORM—

Here contours are evenly spaced, and according to the V.I. between them, we know such a slope would be uniformly gentle or steep. (a)

CONCAVE—

Here the contour spacing increases from high to low. They are close together at the top of the slope, and widen out as they near the bottom. (Read from high figures to low.) (b)

CONVEX

Here the contour spacing decreases from high to low. They are wide apart at the top of the slope, and close in as they near the bottom. (Read from high figures to low.) (c)

POINTS TO NOTE:

(1) Where a lower contour bends towards a higher contour, a **re-entrant** (valley-stream) is indicated.

(2) Where a higher contour bends towards a lower contour, a **spur** is indicated.

(3) Contours close to each other indicate **steep ground;** the further they are apart, the more nearly level is the ground.

(4) **Remember** that unless a spot height is given, features which approximate to the V.I. of the contours are not shown by a map. Thus on a map with V.I. of 50ft., features up to 40 odd feet would not be shown, while on a map with a V.I. of 200ft., features up to 190ft. in height would not be shown.

(5) Get hold of a map and study its contours.

WHAT TO LOOK FOR IN A MAP:

Start with the NATURAL features and look for the DRAINAGE SYSTEM—rivers, streams. HILL FEATURES—peaks, spurs, passes, knolls, etc. NATURAL COVER—trees, hedges, cultivation, etc. Then go on with TOWNS—villages, roads, railways, canals, etc. For SIGNAL purposes estimate VISIBILITY, ROUTES, CONCEALMENT, etc.

VISIBILITY:

It is often necessary to find from the map which two points can be seen, the one from the other. This can often be found by simple inspection of the map—but in all cases the extent to which visibility can be judged, depends upon the V.I. of the map. If the V.I. is small, say 10ft., unrepresented ground features are also small, but the larger the V.I. the larger the unrepresented features. This fact cannot be stressed too much. VISIBILITY should seldom be assumed from calculation only—UNLESS common sense shows that there can be no intervening obstacle. Features such as buildings and trees must be taken into account.

AIDS TO JUDGING VISIBILITY:

(1) Two points on the opposite side of a valley, with no intervening feature **should** be intervisible.

(2) Two points with a feature between them higher than both will **not** be intervisible.

(3) Two points with a feature between them higher than one point **may** be intervisible.

(4) Two points on a CONVEX slope are rarely intervisible.

(5) Two points on a CONCAVE slope **should** be intervisible.

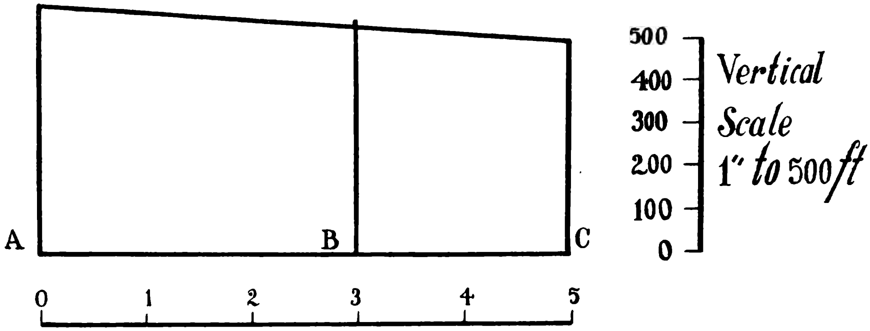
(6) Two points on LEVEL ground, or UNIFORM slopes, **are** intervisible, unless objects such as houses or trees intervene.

METHODS OF SOLVING VISIBILITY PROBLEMS:

There are several methods of finding whether one point is visible from another. The "Manual of Map Reading" should be studied in this regard. Two simple methods are given below.

(a) By constructing a simple diagram:

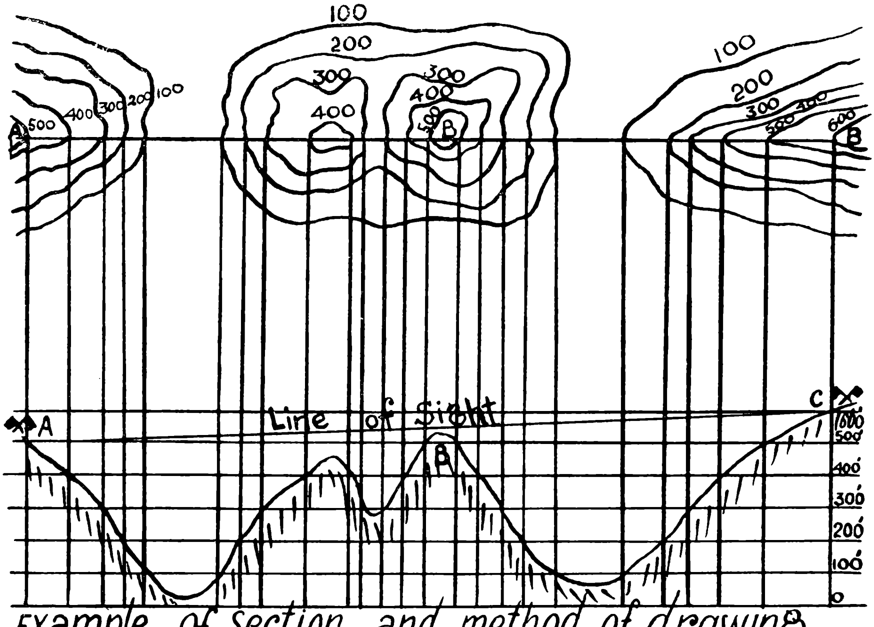
Draw a line AC to represent the distance to scale, from A to C, and mark in intermediate point B. At A, B, and C draw vertical lines to represent the height above sea level at these points. (The scale at the verticals need not be the same as that of the map. It is advisable to take a scale of 1 inch to about 500ft. and so avoid awkward fractions.) By joining the tops of the verticals at A and C, it is possible to see whether the intermediate point (B) would obscure the view or not. In the example here given the position B was 550ft. above sea level, between A at 600ft. and C at 500ft., and lying three miles from A and 2 miles from C. The top of the vertical at B stands just above the line of sight joining the tops of those at A and C, and therefore obscures the view.



Horizontal Scale ½″ to 1mile (1/126720)

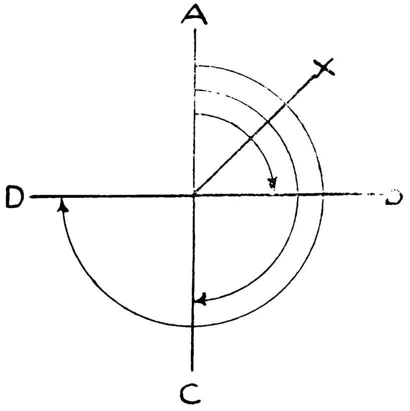
(b) By drawing a section.

This is a more lengthy process and is generally not necessary. It is, however, simple and accurate.



Example of Section and method of drawing same

NORTH POINTS AND BEARINGS:



A bearing is the angle measured clockwise, from one fixed line to any other line (see diagram).

The angle or bearing from A to B is 90 deg.

The angle or bearing from A to C is 180 deg.

The angle or bearing from A to D is 270 deg.

A bearing on a point X half way between A and B would be 45 deg.

° is the sign for "degrees."

Bearings in map reading may be TRUE, GRID, or MAGNETIC—and in each case is taken from the North Point.

WHAT IS TRUE NORTH (T.N.)?

True North means the direction of the north pole from the observer.

WHAT IS GRID NORTH (G.N.)?

Grid North is the direction in which the grid lines point towards the top of the map. All grid lines are drawn parallel to each other, and do not converge inwards as would T.N. lines (or as they are called, MERIDIANS).

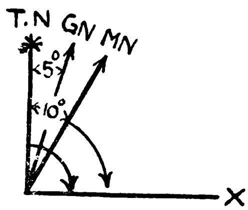
WHAT IS MAGNETIC NORTH (M.N.)?

Magnetic North is the direction in which the compass needle points unaffected by any local attraction.

CONVERSION OF BEARINGS:

Bearings may be taken with reference to T.N.—M.N.—or G.N.—and may have to be changed from one type of bearing to another. On a gridded map, all bearings must be given with reference to G.N.—which means that all bearings taken on the ground with a compass would have to be converted to Grid Bearings before they could be plotted upon a map, and vice versa. (Gridded maps show in the margin the angle between G.N. and M.N.—with an additional note stating the angle between G.N. and T.N. for that sheet.)

Magnetic Variation



Magnetic variation is the difference between T.N. and M.N. It varies for different parts of the world, and also increases, or decreases yearly.

In the example opposite the variation is 10° East. A bearing from T.N. to the point X would be 90°—but a bearing from M.N. to the same point would be 10° less. Had the Magnetic Variation been west of T.N.—the M.B. would have been 10° more than the T.B. From this we get:—

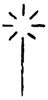
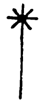
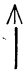
WHEN M.V. IS EAST:

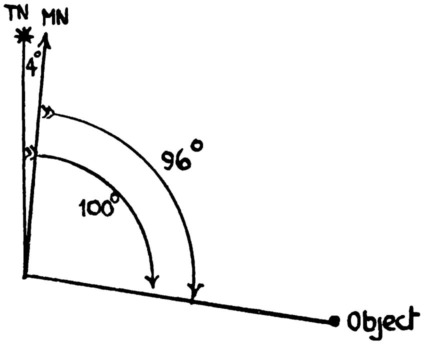
(1) Subtract the variation from a T.B. to convert to M.B.
(2) Add the variation to a M.B. to convert to a T.B.

WHEN M.V. IS WEST:

(1) Add the variation to a T.B. to convert to a M.B.
(2) Subtract the variation from a M.B. to convert to a T.B.

This can be memorized as "East least West best" when converting True to Magnetic. A third line can be drawn to represent G.N., and bearings changed in a similar manner (see G.N. line in example and work out Grid Bearing of X).

In sketches or maps T.N. is usually drawn thus  or  representing the sun, the source from which it can be obtained and M.N. thus  representing the arrow-head on the compass card.

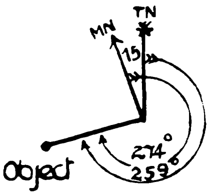


Problem 1.

If the M.V. is 4° E. and the T.B. of an object is 100°, what is the M.B.?

SOLUTION:

If it is 100° from T.N. to the object, then it is obvious that from M.N. to the object will be 4° less—that is, 96°.



Problem 2.

If the M.V. is 15° W. and the M.B. of an object is 274°, what is the T.B.?

SOLUTION:

If it is 274° from M.N. to object, then it must be only 259° from T.N. to object.

PROTRACTOR:

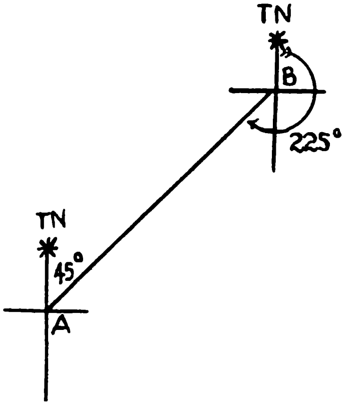
The rectangular service protractor is 2in. x 6in. It has six useful scales printed on the front and six on the back, all of which show "primaries" and "secondaries." The protractor has degree graduations along three edges of the face, the remaining edge being the zero edge. The point from which the rays are drawn is marked by an arrowhead on the zero edge. There are two sets of figures to the graduations. The outer reads from 0° to 180° and the inner from 180° to 360°. On measuring a bearing with the service protractor it should be noted that the reverse bearing can be read at the same time.

The protractor is used for measuring the bearing from one point to another on the map and for plotting on the map, bearings obtained with the compass.

Bearings obtained from the map are either T.B. or G.B. and they must be converted to M.B. for use with the compass.

Bearings obtained with the compass are M.B. and must be converted to either T.B. or G.B. before being plotted on the map.

Care must be taken to note from which of the two points the bearing is to be taken. In the sketch the bearing from A to B is 45°, but from Bto A it is 225°.



Rules for reading a bearing with a Protractor:

(1) First draw a light line between the two objects. If they are close together the line must be extended beyond the "to" object so that the protractor will not hide the line.

(2) Place the zero mark of the protractor on the "from" object with the graduations of the protractor to the right if the bearing is less than 180° and to the left if the bearing is more than 180°.

(3) Place the edge of the protractor exactly parallel with the grid lines (if any) or the true north.

(4) Read the bearing where the pencil line cuts the graduations.

BACK BEARING:

A back bearing is one taken on the same line but in an opposite direction to a forward bearing. In the sketch above the bearing of B from A is 45°. If we want the back bearing we add 180° to 45° and obtain 225° as the result. This is the bearing of A from B.

Rules:

(a) If the forward bearing is **less** than 180° add 180° to it to obtain the back bearing.

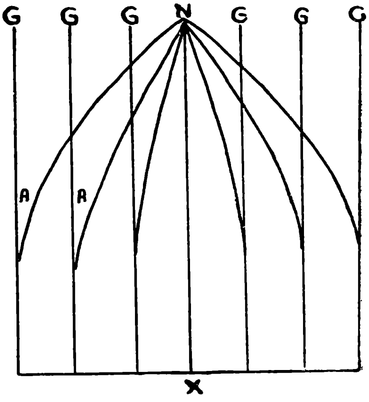
(b) If the forward bearing is **more** than 180° subtract 180° from it to obtain the back bearing.

SYSTEMS OF REFERENCE:

There are many methods used whereby references may be given on maps. We are concerned with those methods using what is known as a GRID system; of which also, there are several varieties. Basically, however, all grid systems are the same. If we understand the principles of "gridding," we can handle any system with which we might have to deal.

WHAT IS A GRID?

A grid is a system of squares formed by lines which represent progressive (equal) distances East and North of a Fixed origin, or starting point. It is usual to make one grid line coincide with a meridian; a meridan being simply a True North and South line. All other north and south grid lines are drawn parallel to this standard meridian, and do not point to the true north, but to a different and imaginary point called the Grid North. Grid north is east of true north when the grid lines are drawn east of the standard meridian, and west of true north when the grid lines are drawn west of the standard meridian. The angle between grid north and true north is known as the "angle of convergence," and this angle increases the further the grid line departs from the standard meridian. This angle of convergence could be called grid variation, and is usually shown in the map margin.



G—grid north.

A—angle of convergence.

NX—standard meridian.

N—true north pole.

Reference by means of Grid:

In figure 1 over, any position along line "A" can be given as so many tenths East of "A," and with line "B" as so many tenths North of "B," but in neither case can a complete reference be given for points Z and X, which are not on the lines. In figure II, however, we have drawn lines A and B at right angles to each other and now we can give a reference to point X by saying it is so many tenths east and so many tenths north of point AB (which is now our starting point). This is precisely what we do when giving a grid reference. In the above case the letters AB can be called the co-ordinates and the figures denoting tenths as the EASTING and NORTHINGS. Our reference is A6B6.

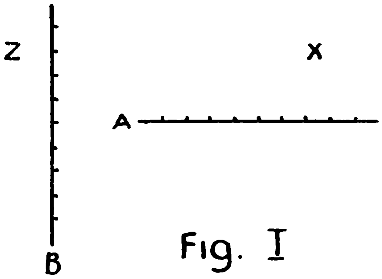


Fig. I

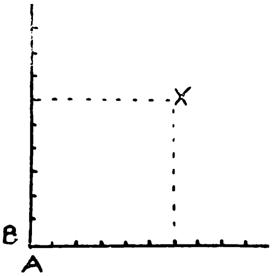
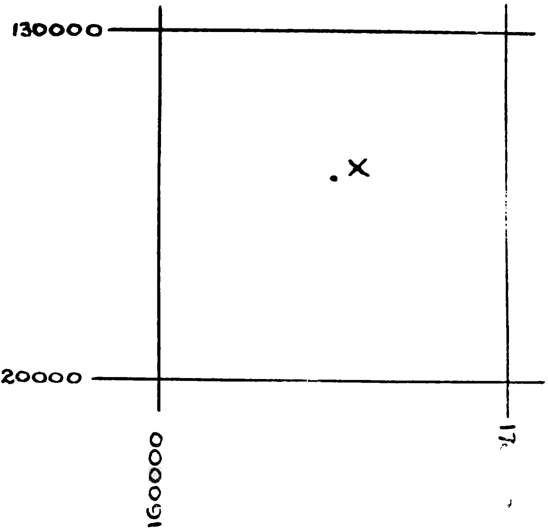


Fig II

Palestine Grid: Now let us consider an actual grid. Palestine maps are gridded with a series of parallel lines drawn east and north of a point of origin lying outside the country itself. (It is evident that any area to be gridded must have a point of origin further south and further west than any points in the area under consideration.) These grid lines are drawn 10 kilometres apart and form a series of squares having sides of 10,000 metres. Consider figure 3 below.



This represents an area bounded by the EASTERLY grid lines 160000 and 170000 and the NORTHERLY grid lines 120000 and 130000. In effect it is a square and we can refer to this square by giving the co-ordinates of the S.W. corner, in this case 1612 (large figures only). These two groups of figures are now our starting figures for any reference within this square. Look at point X. From our previous examples we know we have to find how many tenths east, and how many tenths north of the S.W. corner it is, and so obtain a reference. Here it is 165125. But consider again. The sides of this square are 10000 metres and if we sub-divide these tenths and draw lines east and west and north and south we shall have split the large square into 100 small squares. Each of these smaller squares has sides of 1000 metres and so our reference is not very accurate. Hence on Palestine grids we have to divide the 10 kilometre lines into hundredths and so obtain accuracy of within 100 metres. This is usually done by using a suitable romer or measuring card on which the divisions are already printed. So our references are now:—

4 figure ref.:	1612	correct to 10,000 metres square.
6 figure ref,:	165125	correct to 1,000 metres square.
8 figure ref.:	16551256	correct to . 100 metres square.

To find a reference on the above system: Breaking the reference into halves, using the 8 figure reference we get 1655 1256. Disregard for a moment the last pairs of figures. This leaves 16-12. Look for the square whose S.W. corner bears these co-ordinates; to be found in the map margin. Then take the remaining eastings (55) and measure them off. Do the same for the northings and we have the required point. N.B.: EASTINGS always come first.

Australian Grid System: This system is based upon the Modified British System, using however, yards instead of metres. Australia was divided into eight zones of 6° longitude, each zone overlapping half a degree on each side. Each zone was then subdivided by parallel sets of vertical, and of horizontal lines into squares of 10,000 yards. These larger squares were further subdivided into 1000-yard squares. To obviate a confused grid system it was found necessary to give each zone a point of false origin. These points of false origin are all outside Australia. Map-references in this system are normally six figure ones and are accurate to nearest 100 yards. (Method of using system is given in map-margin.)

Other grid systems: Besides the Palestine grid shown above there are the British and Modified British Systems, with various foreign systems. They differ only in the methods of lettering and numbering the grid lines and the squares formed by them and in all Service maps, at least, an example is always given in the margin showing how to use the grid employed. Whatever method is used Eastings always come first and Northings second, and the same number of figures must be given in each case.

Types of References:

Palestine	1/100,000	See examples given above.
Bardia	1/50,000	20451065 correct to nearest 100 metres.
Benghazi	1/500,000	(s) P6555 correct to nearest 1,000 metres. (s) P — is reference to a square with sides of 100,000 metres.
Tobruk	1/500,000	545555—correct to nearest 1,000 metres. (Here again large square has sides of 100,000 metres.)
Tobruk	1/50,000	4125 4365—correct to nearest 100 metres.

In each of these examples the grids were numbered in different ways, but no difficulty was experienced in using them.

ORIENTING A MAP: A map is said to be oriented or "set" when it is laid out in direct correspondence with the ground so that T.N. on the map corresponds to the North Point. If after setting, the direction between features on the ground are then compared with the same directions as shown on the map, they will be seen to be identical.

SETTING BY COMPASS: Lay the compass opened over the "Magnetic North" line given on the map, so that the hair line or the notches representing the zero line of the compass fall directly over the M.N. line of the map. Now revolve the map and compass together until the needle pointing to M.N. is on the same line. The map is now set.

SETTING BY OBJECTS ON THE GROUND: (a) If your position can be identified as some point marked or known on the map, the next step is to identify (also on the map) some distant object which can be seen on the ground. Join the two points on the map by a straight line. Then turn the map about until this line points to the distant object. The map is now set.

(b) If your position has **Not** been identified on the map the map may still be approximately set by identifying on it some prominent objects that can be seen on the ground. The map is then held so that the directions between these objects as they appear on the ground and on the map are parallel to one another.

Setting by Sun and Stars: It is necessary first to ascertain true north by the sun, using the "watch" or the "shadow stick" method, or by the stars at night, and when this is done to turn the map so that true north on the map corresponds with true north as determined.

FINDING NORTH BY WATCH AND SUN:

(a) **Northern Hemisphere.**—Correct the watch to local time but DON'T include allowance for "Summer Time." Point the hour hand at the sun. Bisect the angle between the hour hand and XII (twelve o'clock). The bisecting line points to TRUE SOUTH.

(b) **Southern Hemisphere.**—Correct watch as above. Point XII at the sun. Bisect the angle between XII and the hour hand. The bisecting line points to TRUE NORTH.

This method is approximate only—and is useless within the TROPICS.

RESECTION:

This is a means whereby we can plot our position on the map from actual objects on the ground.

Method (A): Pick out three objects on the ground which are also marked on the map. (If possible choose objects well apart from each other.)

Pin a piece of tracing paper on a board and lay a ruler upon it. From any convenient point marked on the paper as a pivot, and without moving the board, draw a line along the straight edge of the rule in the direction of each of the three chosen distant points. Then remove the piece of tracing paper from the board and apply it to the map so that the three lines pass through the distant points as marked on the map. The pivot point, i.e., where the three lines meet, is the required position and can be pricked on to the map. Ordinary paper can be used in lieu of tracing paper.

METHOD "B":

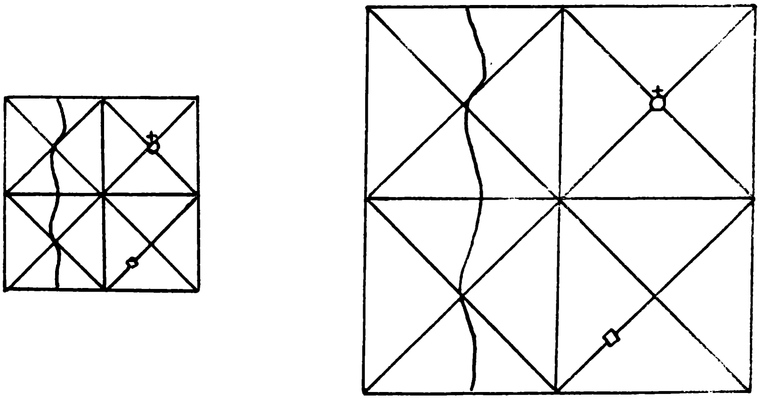
(For this method we require a prismatic compass, a protractor and the map.) Select three points on the map which are visible on the ground, from the point at which you are standing. Using the compass take a careful bearing on to each of the selected objects. (These are FORWARD bearings.) Convert them to BACK bearings then change these back bearings, which are MAGNETIC, into GRID bearings, taking the grid variation from data in the map margin. (If the map is **NOT gridded,** the magnetic bearings would have to be changed into TRUE bearings.)

Now using the protractor plot each of these GRID bearings on the map from the objects selected. Where these lines intersect is approximately the required position. The more careful one is in taking the bearings and plotting them on to the map, the more accurate will be the final result. Make all pencil lines as lightly as possible and have the pencil sharp pointed.

MAP ENLARGING: Enlargement in itself adds nothing to the detail on a map, but it may serve as a basis for a more detailed sketch, or to provide room for writing notes and descriptions. Remember that there must be a proportion between the original and the enlargement. Thus if you are going to enlarge a portion of a map, say, four times, measure the sides of the part to be enlarged and draw the sides of your enlargement four times as long.

METHOD EMPLOYED: Usually what is known as the Union Jack method is employed. A Union Jack is drawn on the map over the part to be enlarged, and then a proportional Union Jack drawn on a piece of paper.

Detail is then copied from the smaller Union Jack on to the larger, making certain that the detail is put on the large Union Jack in the same place as it was taken from the smaller Union Jack.



Lines for Union Jack to be drawn very lightly.

In addition to the above method, we could make an enlargement by using proportional dividers, two romers of suitable sizes, photography, or by employing any device we may know of which will do the task accurately and without undue delay.

NAVIGATION BY THE STARS:

Finding True South by the Stars.

In the Southern Hemisphere there are no bright stars to indicate the South Pole, but by using the constellation known as the Southern Cross, the approximate South Pole may be found readily. Unfortunately, the Southern Cross is not always visible in all parts of the continent; also there are False Crosses, but once having recognised the True Cross, it will be hard to be deceived by the False Crosses. A direction to the True Cross will be found in the constellation Centaurus. Looking at Diagram I, it is easily seen how the Southern Cross can be determined. The two Pointers are in Centaurus; and the angle junction between them will easily determine the approximate bearing of the South Pole.

How to get the South Pole.

Having made sure that one is using the True Cross as a guide, continue the major axis for approximately 4½ lengths, and then cut it with a line extended from the centre of the Pointers. The point of intersection will give the approximate True South.

Diagram II shows how it is possible to determine the Celestial Polar Star by means of the Pointers, and the surrounding constellations.

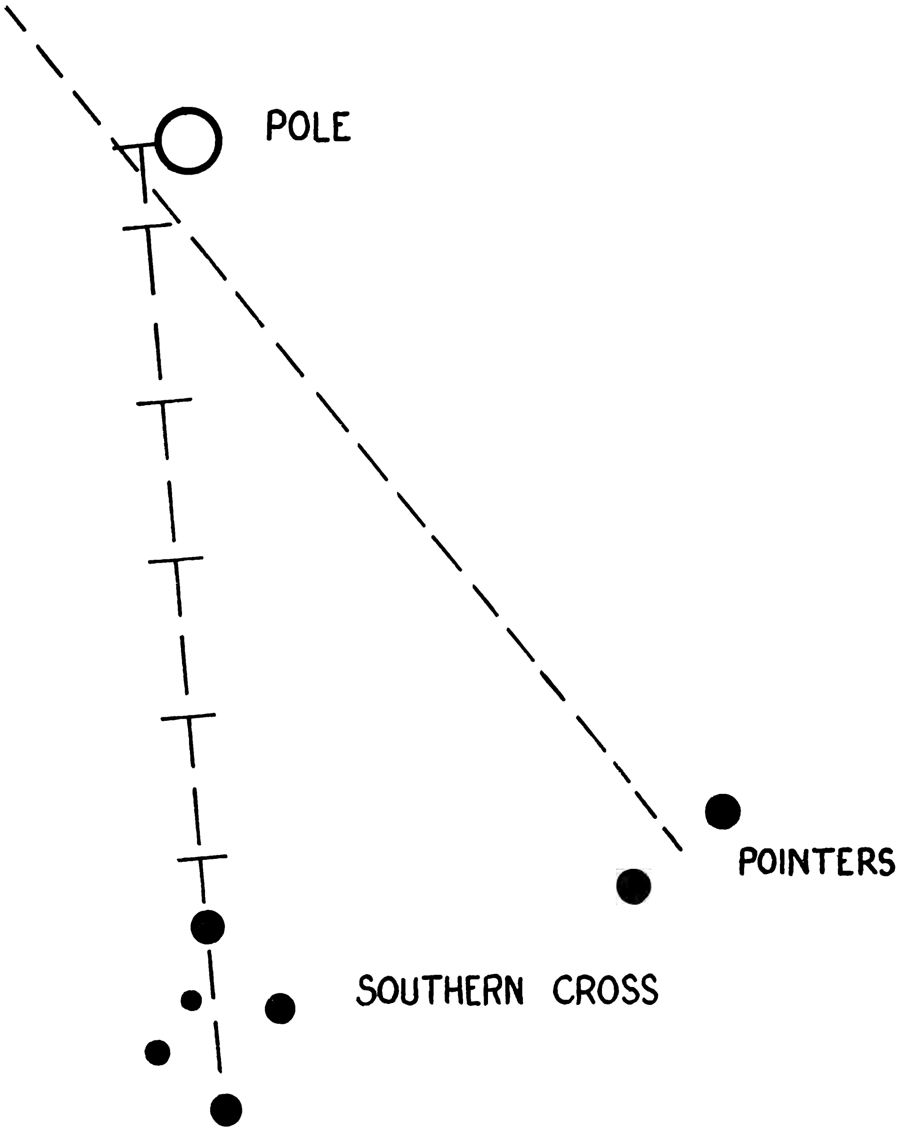


Diagram I.

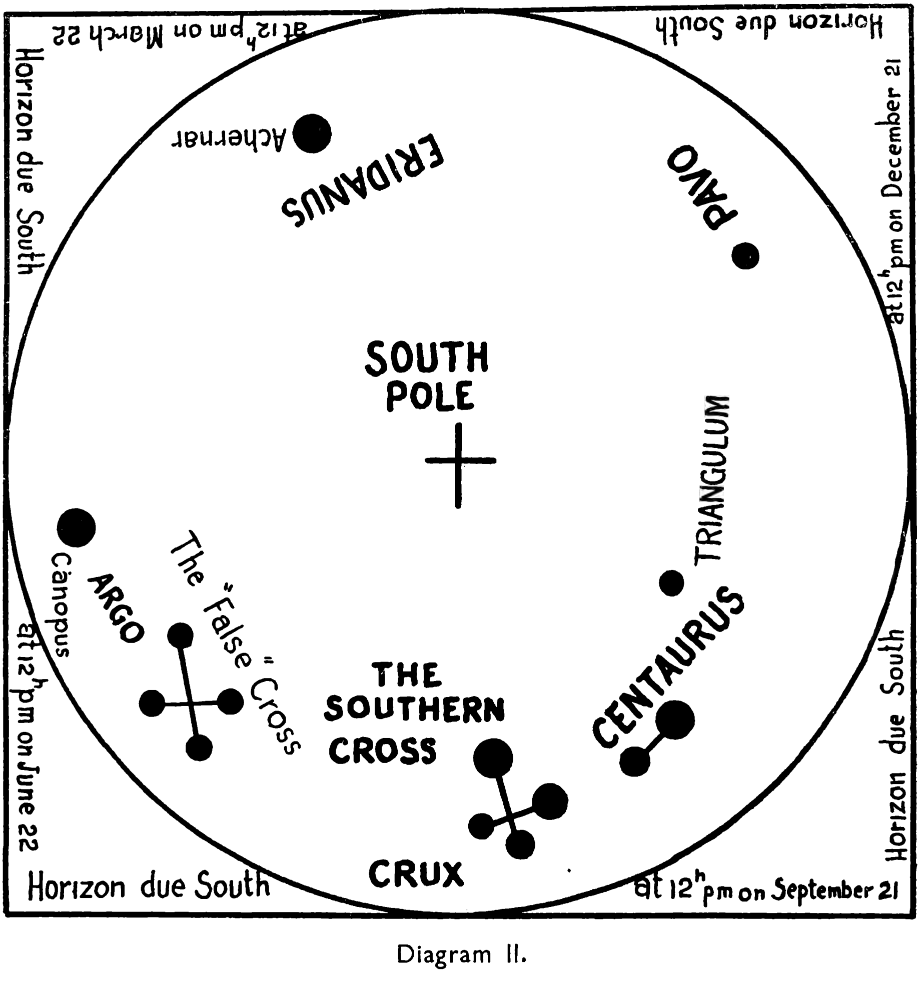
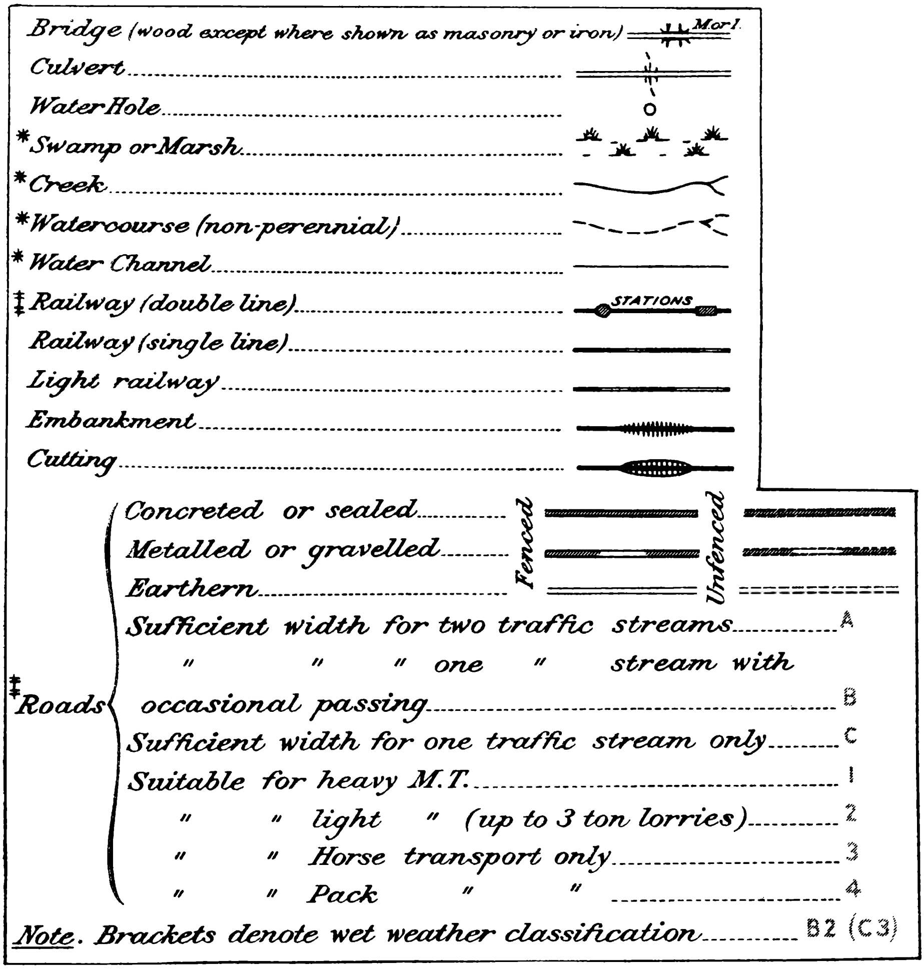

at 12h pm on March 22
Horizon due South
Horizon due South
at 12h pm on December 21
Achernar
ERIDANUS
PAVO
SOUTH POLE
TRIANGULUM
Canopus
ARGO
The "False" Cross
THE SOUTHERN CROSS
CENTAURUS
CRUX
at 12h pm on June 22
Horizon due South
Horizon due South
at 12h pm on September 21

Diagram II.

APPENDIX I

CONVENTIONAL SIGNS FOR USE ON AUSTRALIAN MAPS



Bridge (wood except where shown as masonry or iron) — M or I

Culvert

Water Hole

**Swamp or Marsh*

**Creek*

**Watercourse (non-perennial)*

**Water Channel*

‡ *Railway (double line)* — STATIONS

Railway (single line)

Light railway

Embankment

Cutting

‡ *Roads*

- *Concreted or sealed* — *Fenced* / *Unfenced*
- *Metalled or gravelled*
- *Earthern*
- *Sufficient width for two traffic streams* — A
- *" " " one " stream with occasional passing* — B
- *Sufficient width for one traffic stream only* — C
- *Suitable for heavy M.T.* — 1
- *" " light " (up to 3 ton lorries)* — 2
- *" " Horse transport only* — 3
- *" " Pack " "* — 4

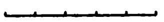
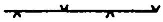
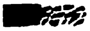
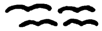
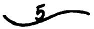
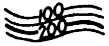
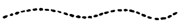
Note. Brackets denote wet weather classification — B2 (C3)

NOTE :

* Conventional signs shown in blue on military maps.

‡ Conventional signs, shaded thus /////, shown in red on military maps.

APPENDIX I Contd.

House		■
Garage		■G
School		■S
Hotel		■H
Blacksmith's Shop (forge)		■F
Church		+
Mill or Factory		♠
Lighthouse		✱
Telegraph or Telephone line		
Post Office		P
Post & Telegraph Office (in villages)		T
Electric Transmission line		
Wind Pump		Ɪ
Cemetery		🄲
ϕ*Timber*		
ϕ*Scrub*		
Trig. Stations and altitude	*First Class*	Δ905′
	Second	△652′
	Third	⊙529′
	Fourth	• 206′
**Fathom lines*		
∞*Contours*		
Track		
Stone Wall		——

NOTE : ϕ Conventional signs shown in green on military maps.
* ,, ,, ,, ,, blue ,, ,, ,,
∞ ,, ,, ,, ,, brown ,, ,, ,,

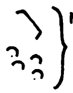
APPENDIX II.

MILITARY CONVENTIONAL SIGNS TO BE USED ON MAPS, SKETCHES OR ANNOTATED PHOTOGRAPHS.

BATTERIES & GUN EMPLACEMENT

General.

When scale allows individual emplacements, fixed by photo, are to be shown.



Nature of Arty. :—
6" How.
18 Pdr.

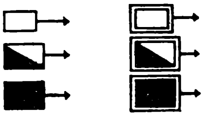
ANTI-TANK GUN

No Concrete Concrete

Projected

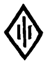
Under Construction

Completed



(Nature of gun to be stated, i.e., 2pdr. or 25m.m)

Anti-Tank Guns (for use on maps of 1 :25,000 and larger. Specially in field sketching).

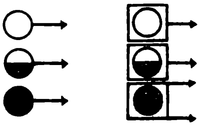


MACHINE GUN

Projected

Under Construction

Completed



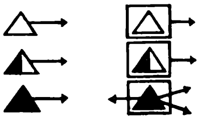
Machine Guns (for use on maps of 1 :25,000 and larger. Specially in field sketching).

BREN GUN

Projected

Under Construction

Completed

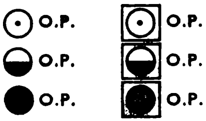


OBSERVATION POST

Projected

Under Construction

Completed



Note—Arrows show line of fire of gun or (if in concrete) direction of loopholes

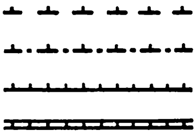
ANTI-TANK DITCH

Projected

Under Construction

Completed

Facing both ways.



SIGNS WILL BE SHOWN RED FOR BRITISH (AND ALLIES) AND IN BLUE FOR THE ENEMY.

(SPECIAL COLOURS FOR ARMD. UNITS—DIV. H.Q. AND DIV. TPS., BLACK. SENIOR BDE., RED. JUNIOR BDE., GREEN. SUP. G P., BROWN. UNITS, YELLOW

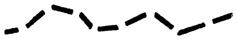
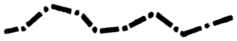
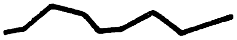
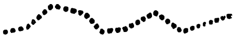
MORTAR

Projected	○ M	Nature of Mortar to be shown.
Under Construction	◒ M2″	
Completed	● M3″	

ANTI-AIRCRAFT

A Section of Guns		Nature of A.A. Guns to be stated, i.e. 3·7″ 3 or B (Bofors)
Machine Gun		
Searchlight		
Visual Plotting Station		

TRENCHES

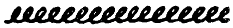
Projected	
Under Construction	
Completed	
Old and Disused	

CRATERS

Site for	
Charged	
Blown	

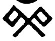
* Demolitions, Craters, Flame Traps, Mine and Minefields will be shown in Green.

OBSTACLES Wire Entanglements—

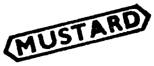
Abatis	//////////////////////////////////
Single (on posts)	XXXXXXXXXXX
Multiple (on posts)	▩▩▩▩▩▩▩▩▩▩
Concertina	
Chevaux de Frise	-X—X—X—X—X—X-

DUMPS

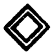
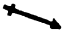
Supply	S
Petrol	P
Ammunition	A
Engineer	E
Hutments	◇◇
Dug-out	◆◆
Signal Office (Telephone or Telegraph)	○T

Signal Office (Concrete)	T
Wireless Telegraph Station	⊕ W/T
Radio Telephony Station	⊕ R/T
Beam Station	⊕ B
Direction Finding Station	⊕ D/F
Visual Signalling Station	
Hospital, Clearing Station or R.A.P.	⊞
Beach Light	
Railway Stop	X

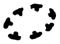
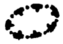
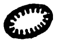
GAS

Gas Projectors	G
Gassed Areas (shaded yellow if possible)	 MUSTARD

TANKS

Anti-Tank Obstacle	■ ■
Tank Trap	
Road Block	X
Anti-Tank Rifle	

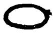
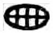
INUNDATIONS

Projected	
Under Construction	
Completed	

BRIDGES

Weight Capacity of Bridges and Culverts in tons	⑫

BRIDGE DEMOLITIONS

Proposed	
Charged	
Blown	

EMBANKMENTS & CUTTINGS

Height of Enbankment in feet	+ 9
Depth of Cutting in feet	− 10

WATER

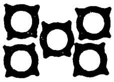
Width of Waterway in feet	16w
Depth of Waterway in feet	5d

WOODS

Average diameter of trees in inches	5d
Average spacing of trees in feet	10s

MINE

MINEFIELD



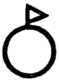
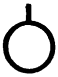
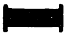
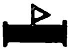
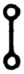
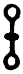
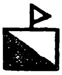
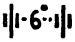
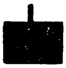
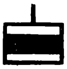
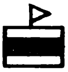
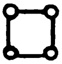
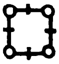
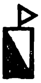
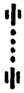
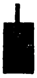
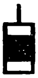
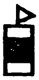
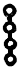
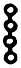
BEACH MINES

Electrically Fired	(E).
Contact	(C).

FLAME TRAPS

TROOPS & HEADQUARTERS

Titles will be written alongside the appropriate sign and the authorised abbreviations used

UNITS	Cav.	Arty.	Inf.	Tks.	Armd. Car or Carriers	Tpt.	
						H.T.	M.T.
Individual							
General							
Column of Route							

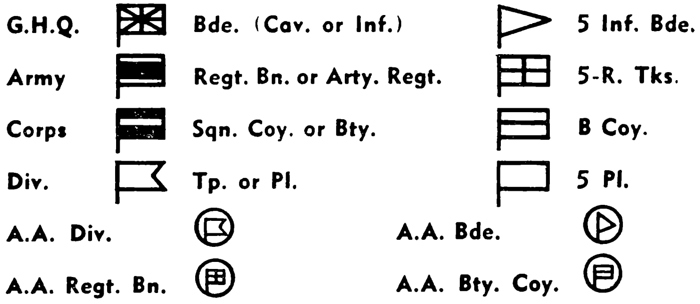
PARACHUTE TROOPS

P The frame enclosing the area in which Parachute Troops have been reported

AIR-BORNE TROOPS

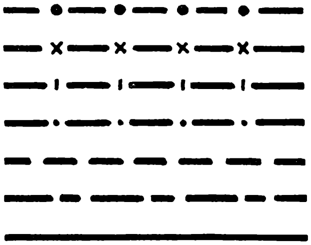
A The frame enclosing the area in which Air-Borne Troops have landed

HEADQUARTERS



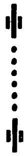
BOUNDARIES

Inter Army
,, Corps
,, Division
,, Brigade
,, Battalion
Armd. Units—Centre Line
Report Line

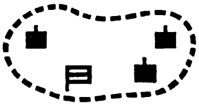


EXAMPLES

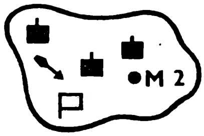
Fd. Regt. R.A.
(in column of route)



Unit deployed—
one company

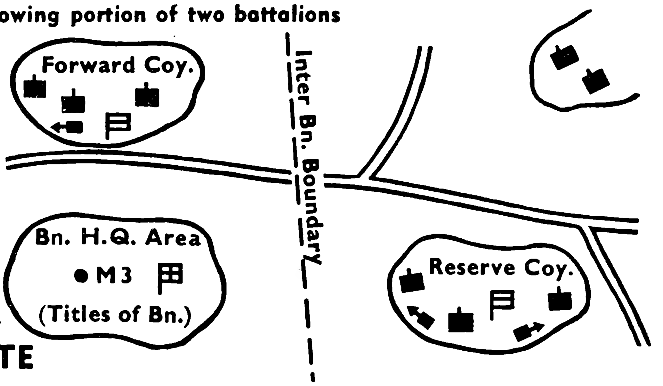


Defended locality
one platoon



TROOPS IN DEFENCE

Showing portion of two battalions



NOTE

These examples show the use of signs and are not to be taken as standard dispositions

NOTES.

NOTES.

By Authority: Victorian Railways Printing Works, North Melbourne. 2525/42